MANUAL OF OPERATION

FOR

ACCUCOM

MODEL 9200

TDM DATA ERROR CORRECTOR

INTERNATIONAL DATA SCIENCES, INC.

ADVANCED TECHNIQUES IN DATA COMMUNICATIONS

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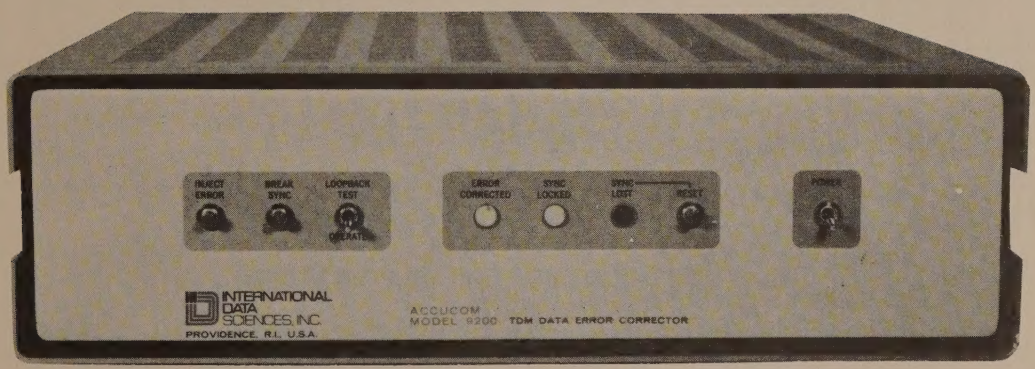

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1.0 INTRODUCTION

The International Data Sciences Model 9200 TDM Error Corrector is a full-duplex error-correction system capable of correcting bursts up to 3200 bits or equivalent line dropout.

The error corrector contains an encoder, a decoder, and elastic buffer memory associated with each. The transmitter buffer accepts data from a TDM transmitter and delivers it to the encoder, where a powerful error detection code and synchronization pattern are incorporated into the data stream. The decoder interprets the information contained in the incoming data stream and takes action for error recovery when an error, whether random or burst, is detected. Loss of synchronization is detected within milliseconds after its occurrence and recovery is carried out as if an error burst had taken place. Generally only correct data enters the receiver buffer which then delivers it to the receiver TDM at the appropriate rate. However, when the burst-correcting capability of the system is exceeded, data is passed uncorrected to the receiver TDM. As line conditions improve, the system recovers and is again able to correct errors within its rated capability.

The Model 9200 DCE interface connects to any synchronous full-duplex modem. At the TDM interface it appears to the TDM as the modem would, and supplies timing at a rate slower than the actual modem clock by an amount equal to the overhead used by the Model 9200. Various ratios of TDM to high-speed modem data rate are available, depending on the equipment configuration in the system.

A number of switches and indicators are provided on the front panel to allow an operator to perform tests to establish that the system is operational and to observe the on-line performance from the behavior of the indicators.

2.0 OPERATION

Each Model 9200 Error Corrector consists of a Transmitter and a Receiver section as illustrated in the system block diagram of Figure 1.

The Transmitter is composed of an elastic memory which acts as a speed converter between the TDM transmitter and the modem, and an Encoder which formats the data by implementing a code which guarantees 99.9999% error detection. The encoding process includes algorithms to protect against random and burst errors, loss of modem synchronization, line dropouts, and errors in the return channel information.

1.0 INTRODUCTION

The International Data Sciences Model 8200 ARQ Error Corrector is a full-duplex error-correction system capable of correcting bursts up to 3200 bits or equivalent time.

The error corrector contains an encoder, a decoder, and elastic buffer memory associated with each. The transmitter buffer accepts data from a TDM transmitter and delivers it to the encoder, where a powerful error detection code and synchronization pattern are incorporated into the data stream. The decoder interprets the information contained in the incoming data stream and takes action for error recovery when an error, whether random or burst, is detected. Loss of synchronization is detected within milliseconds after its occurrence and recovery is carried out as if an error burst had taken place. Generally only correct data enters the receiver buffer which then delivers it to the receiver TDM at the appropriate rate. However, when the burst-correcting capability of the system is exceeded, data is passed uncorrected to the receiver TDM, as line conditions improve, the system recovers and is again able to correct error within its rated capability.

The Model 8200 ARQ interface connects to any synchronous full-duplex modem. At the TDM interface is capable to the TDM as the modem would, and supplies timing at a rate slower than the actual modem clock by an amount equal to the overhead used by the Model 8200. Various ratios of TDM to high-speed modem data rate are available, depending on the equipment configuration in the system.

A number of switches and indicators are provided on the front panel to allow an operator to perform tests to evaluate that the system is operational and to observe the on-line performance from the behavior of the indicators.

2.0 OPERATION

Each Model 8200 Error Corrector consists of a transmitter and a receiver section as illustrated in the system block diagram of figure 1.

The transmitter is composed of an elastic memory which acts as a speed converter between the TDM transmitter and the modem, and an encoder which forms, and then by inserting a code which guarantees 99.9999% error detection. The encoding process includes algorithms to protect against random and burst errors, loss of modem synchronization, time recovery, and errors in the return channel information.

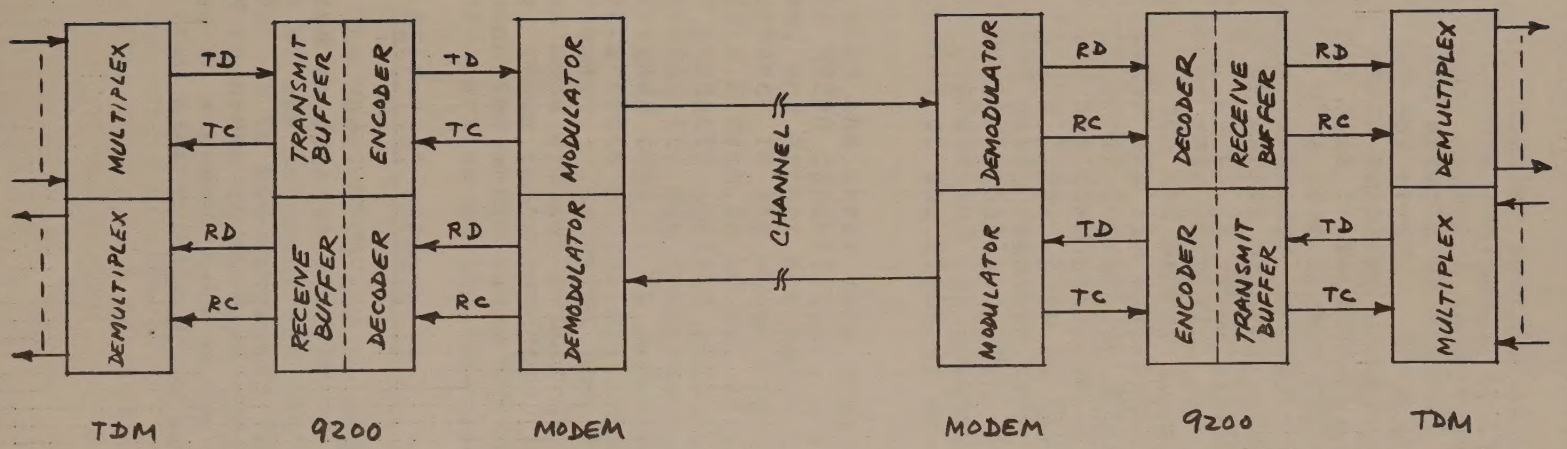
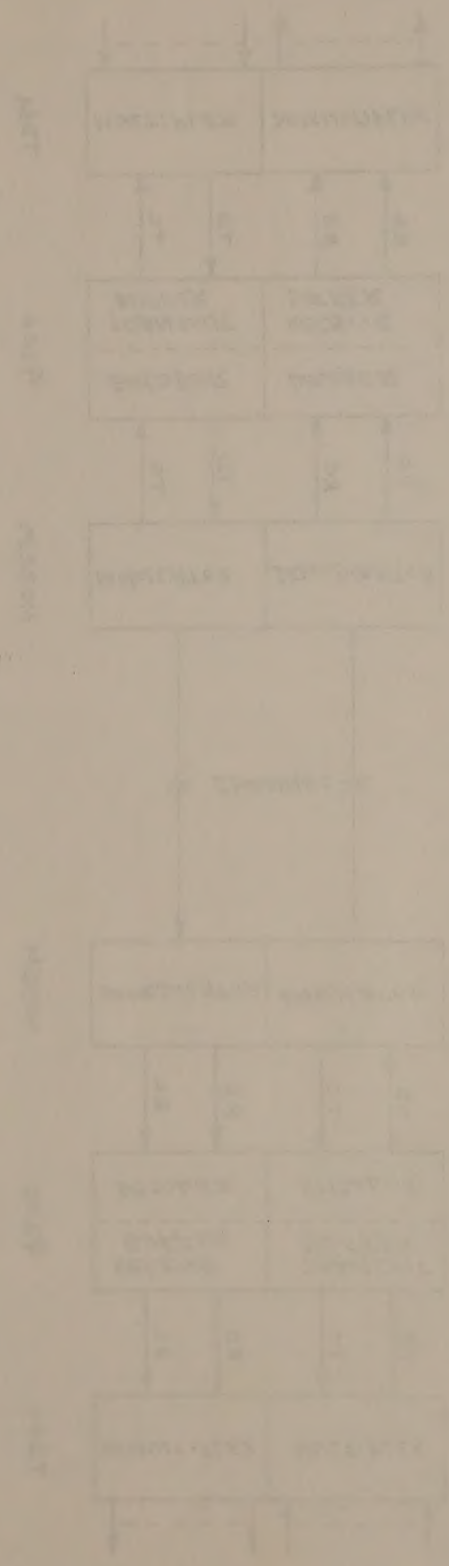


FIGURE 1
TDM COMMUNICATIONS SYSTEM
WITH
MODEL 9200 ERROR CORRECTOR



Transmit Clock is supplied to the TDM at a rate slower than the modem clock. The difference is taken up by the overhead utilized in the Model 9200 to effect error correction.

The Receiver section is composed of a Decoder and an elastic memory analogous to the one located in the transmitter. The Decoder recovers data from the received encoded information and accepts or rejects it based on whether or not it contained any errors. Correct data is entered into the elastic memory which supplies uninterrupted data to the TDM receiver; incorrect data is rejected and retransmission is requested by means of a code transmitted in the reverse channel. There is generally enough correct data in storage to allow for correction of bursts or line dropouts as long as 3200 bits. If the error burst is longer than this, or equivalently, if a high error rate persists, the M9200 enters the "unprotected" state. Since the memory capacity for correct data is exceeded, the Decoder and its associated Encoder are instructed to bypass the error correction algorithm, and data transfers between TDM's and the communication link take place as if no M9200's were in the line. Even as the M9200 is receiving highly corrupted data, recovery from the unprotected state is taking place internally. When the unit momentarily comes out of the unprotected (or bypass) region, it performs error correction on one block of data and returns to the bypass mode.

When the error rate returns to a value within the range of the M9200 capabilities, the system enters the protected region, and errors are again corrected as they occur. A disturbance in the modem clock or a line dropout will cause the data stream to be out of synchronism with the clock. The M9200 protects against this source of error by continuously monitoring its own synchronization pattern. This pattern is so designed that it is detected within milliseconds after the occurrence of the disturbance and is not mistaken for an error burst. The M9200 immediately goes into a resynchronization mode without affecting the transmitter or receiver TDM's, since their interface is with the corresponding elastic memories which carry the operation while the Encoder/Decoder portion of the link re-establishes normal communications.

3.0 SELF-TEST CAPABILITY

The Model 9200 can be completely and conveniently checked to determine whether it is operating correctly by means of the switches and indicators provided on the front panel. It is not necessary for the unit to be connected to a TDM in order to perform these tests, but it must be connected to a synchronous modem or modem simulator to be used as a time base for synchronization.

With the loopback switch in the Loopback Test" position, the M9200 receiver will be synchronized to the transmitter in the same unit. Errors may be injected into the encoded transmitted data by depressing the "Inject Error" pushbutton switch. As the data is looped around and received by the M9200 decoder, the errors are detected and recovery procedures are initiated. The "Error Corrected" indicator will light, signalling that the transmitter is retransmitting the information received in error. If errors continue to be injected by keeping the "Inject Error" switch depressed, the recovery capability will be exceeded and the erroneous information will be passed through to the TDM or terminal equipment. It will be observed that the "Error Corrected" light will be off for a period of time. When the system recovers and error correction can be performed again, the light will flash again every time correction is being effected.

In the loopback mode it is possible to test the Loss of Sync circuitry by depressing the "Break Sync" pushbutton. This action causes a disturbance in the Modem Receive Clock such that a decoder loss of synchronization results. The "Sync Locked" light will go off, the "Sync Lock" light will go on, and the "Error Corrected" light will also flash to indicate a resynchronization operation within the unit. When synchronization is established, the "Sync Locked" light will come back on, and the "Sync Lost" light will stay on until it is reset normally, as an indication of a past loss of sync occurrence.

With the "Loopback Test" switch in the "Operate" mode, and with at least the Model 9200 and the modem at each end of an active link, it is possible to test the end-to-end response of the system by performing the "Inject Error" test. Depressing this pushbutton switch causes errors to be transmitted to the station at the other end of the link. The integrity of the link and the operationality of the Error Correctors is demonstrated by the "Error Corrected" indicator being lit on the same unit where the error was injected. If the error pushbutton is kept depressed for some length of time, the same effect will be seen as in the loopback test, namely, the "Error Corrected" light will flash again, once or twice, then stay off for a while, then flash again, and so on. The explanation is the same: the error-correcting capacity threshold is crossed after a prolonged high error situation, followed by a time of unprotected data transmission, then a return to the error protection operating region, and so on. The "Inject Error" switch may be depressed at any time during normal operation to check system continuity by observing the "Error Corrected" light. When the "Loopback Test" switch is in the "Operate" position the "Break Sync" switch is disabled.

4.0 CONSOLE INDICATORS

The following console indicators are located on the front panel of the Model 9200 TDM Error Corrector

4.1 Error Corrected

Indicates that retransmission is taking place on a block of data received in error by the Error Corrector at the other end of the link.

4.2 Sync Locked

Indicates that the Model 9200 Receiver is synchronized with the Transmitter at the other end of the link. It provides an indication that the Receiver is operating properly.

4.3 Sync Lost

Indicates that at some time in the past there occurred a loss of synchronization in the Receiver. If both "Sync Locked" and "Sync Lost" are lit, the meaning is that a synchronization disturbance has occurred but recovery has taken place and operation is normal.

5.0 CONSOLE CONTROLS

The following Console Controls are located on the front panel of the Model 9200 TDM Error Corrector.

5.1 Inject Error

This pushbutton causes an error to be injected into the data block being transmitted while it is depressed. As a test feature, it is designed so that only the redundancy portion of the block is affected; the data portion is unaltered. Thus, in an operating environment, if the "Inject Error" pushbutton were depressed for a period of time long enough to drive the Error Corrector into the unprotected region, the injected errors are not such that they affect the data being passed on to the TDM receiver.

5.2 Break Sync

This pushbutton is enabled in the "Loopback Test" mode only. It causes a disturbance in the received clock from the modem in order to test the Error Corrector's sync recovery circuit.

5.3 Loopback Test

This switch allows self-test of a single Model 9200, provided a transmit clock is supplied through the modem connector. It connects the Transmitter output to the Receiver input and ties the transmit clock into the receive clock circuitry.

For normal operation, this switch must be in the "Operate" position.

5.4 Reset Sync Lost

This pushbutton resets the "Sync Lost" indicator.

6.0 SPECIFICATIONS AND INTERFACE

6.1 Power

115 or 230 VAC ±10%, 50-60 Hz. Fuse: 1 amp, Slow Blow. Approximately 50 watts.

6.2 Operating Temperature

$0^{o}C$ to $50^{o}C$

6.3 Size and Weight

Desktop: Width 14 1/2", Height 4 1/4", Depth 12", Weight 15 lbs.

Rackmount: Width 19", Height 4", Depth 8 5/8", Weight 15 lbs.

6.4 RS232 Interface

All signals conform to RS232/CCITTV.24 specifications. Two connectors (TDM and DCE) are mounted on the back panel. Signals are listed in Table 1.

The input signals are Received Data, Transmitter Clock, Receiver Clock, and Data Carrier Detector, all required to be low-level and polar, suitable for use with electronic circuitry. In the Error Corrector, these signals are processed through double threshold hysteresis circuits to allow high noise immunity.

The standard Error Corrector with RS232 interface has a noise immunity of four volts nominal. The negative threshold is set at minus two volts and the positive threshold is set at plus two volts. Clamping circuitry allows the positive threshold to be exceeded with signals as large as plus 25 volts and the negative threshold to be exceeded with signals as large as minus 25 volts. See Figure 2 and 3 for threshold and interrelationship details.

6.4.1 Output Signals

Output Amplitude: +12V = Logic "0" = SPACE
-12V = Logic "1" = MARK

Output Impedance: 600 ohms

6.4.2 Input Signals

Input Amplitude: ±3V to ±25V
Input Impedance: 3000-7000 ohms

TABLE I - REAR-PANEL CONNECTOR PIN ASSIGNMENTS

CONNECTOR PIN	RS232B OR C DESIGNATION	TITLE	TDM CONNECTOR DESCRIPTION NOTE: "ON" = POSITIVE VOLTAGE = SPACE = BINARY 0. "OFF" = NEGATIVE VOLTAGE = MARK = BINARY 1.	DCE CONNECTOR
1	AA	Protective Ground	This lead is an electrical equipment frame and power ground.	
2	BA	Transmitted Data	This lead carries the signals that originate in the TDM and are to be transmitted to a remote TDM. An input to the M9200.	This lead carries the signals that originate in the 9200 and are to be transmitted to a remote 9200. An output from the 9200.
3	BB	Received Data	This lead carries the signals that are generated by the 9200 in response to signals from the modem receiver. An output from the 9200.	This lead carries the signals that are generated by the modem in response to signals from a remote modem. An input to the 9200.
4	CA	Request to Send (RTS)	Not used by the 9200. This lead is open at the connector.	This lead is strapped to the "on" condition and indicates that the 9200 is ready to transmit data. An output from the 9200.
5	CB	Clear to Send (CTS)	This lead is strapped to the "on" condition and indicates that the 9200 is ready to accept data from the TDM. An output from the 9200.	Not used by the 9200. This lead is open at the connector.
6	CC	Data Set Ready (DSR)	Not used by the Model 9200. This lead is bussed through from the DCE connector to the TDM connector.	
7	AB	Signal	This lead establishes the common ground reference for all circuits. It is bussed through from the DCE connector to the TDM connector and is connected to the 9200 signal ground.	
8	CF	Data Carrier Detector (DCD)	This lead provides an indication to the TDM that data and clock are being supplied by the 9200. An output of the 9200.	This lead provides an indication to the 9200 that data carrier from the remote modem is being received by the local modem. An input to the 9200.
9-14	--	--	Not used by the M9200. These leads are bussed through from the DCE connector to the TDM connector.	

			TDM CONNECTOR	DCE CONNECTOR
CONNECTOR PIN	RS232B OR C DESIGNATION	TITLE	DESCRIPTION	
15	DB	Transmitter Signal Element Timing (TC)	Signals on this lead are used to provide the TDM transmitter with signal element timing information. An output from the 9200.	Signals on his lead are used by the M9200 transmitter for timing of the data transmitted to the DCE. An input to the M9200.
16	SBB	Secondary Received Data (RD) (s)	Not used by the M9200. This lead is bussed through from the DCE connector to the TDM connector.	
17	DD	Receiver Signal Element Timing (RC)	Signals on this lead are used to provide the TDM Receiver with signal element timing information. An output from the M9200.	Signals on this lead are used by the M9200 Receiver for timing of the data received from the DCE. An input to the M9200.
18,19	--	---	Not used by the M9200. These leads are bussed through from the DCE connector to the TDM connector.	
20	CD	Data Terminal Ready (DTR)	Not used by the M9200. This lead is open at the connector.	This lead is strapped to the "on" condition and serves to maintain the communications channel active.
21	CG	Signal Quality Detector (SQ)	Not Used by the M9200. These leads are bussed through from the DCE connector to the TDM connector.	
22	CE	Ring Indicator (RI)		
23	CH/CI	Data Signal Rate Selector		
24	DA	Transmitter Signal-Element Timing	Not used by the M9200. This lead is open at the connector.	This lead may be unused or connected to the receiver signal-element timing circuitry, depending on the application.
25	--	--	Not used by the M9200. This lead is bussed through from the DCE connector to the TDM connector.	

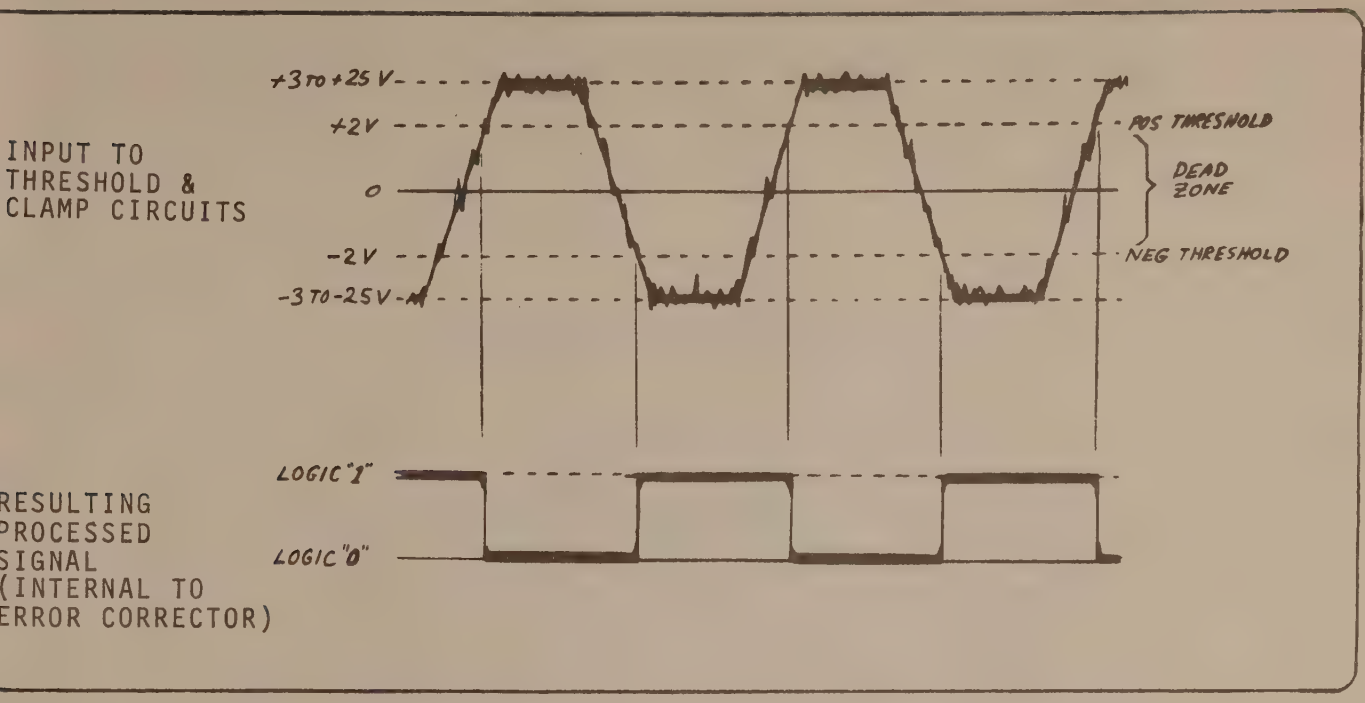


FIGURE 2 PROCESSING OF INPUT SIGNALS

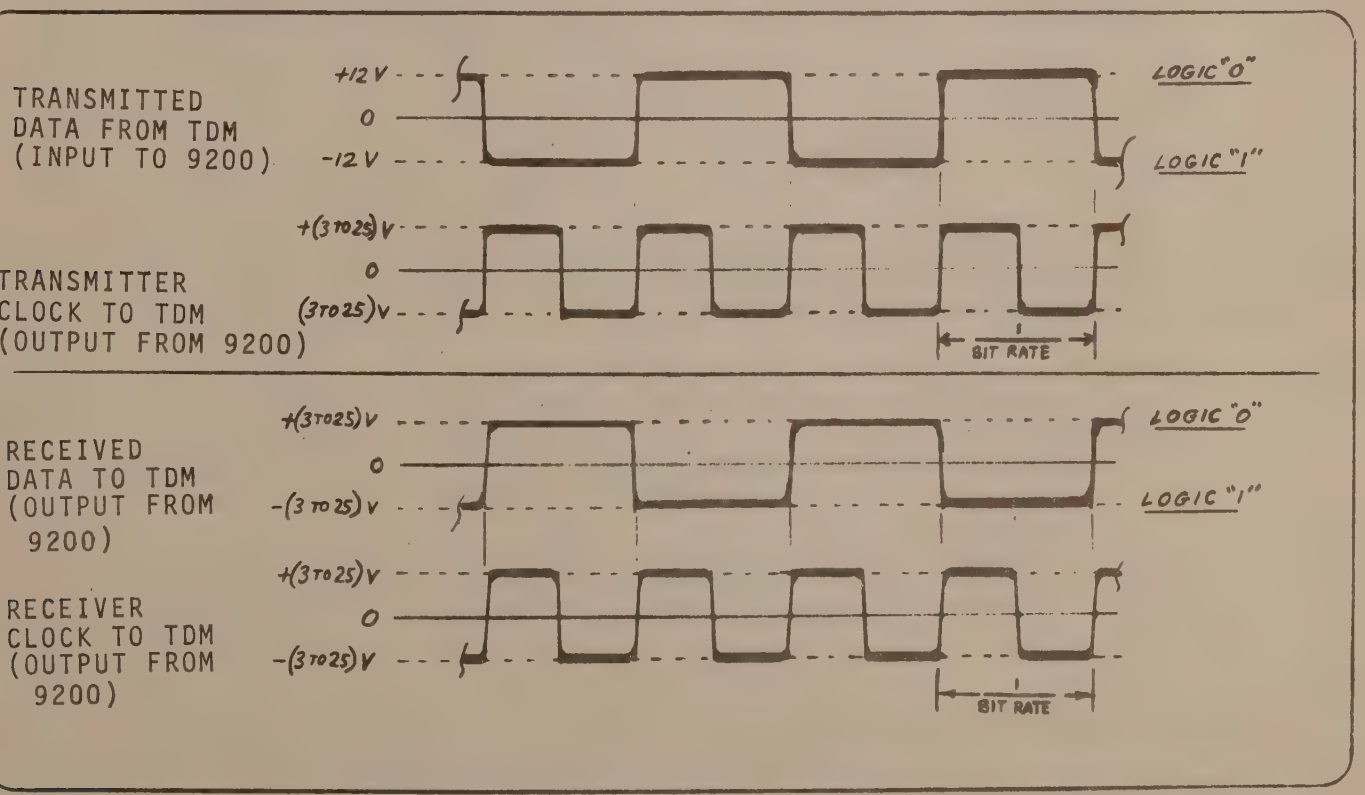
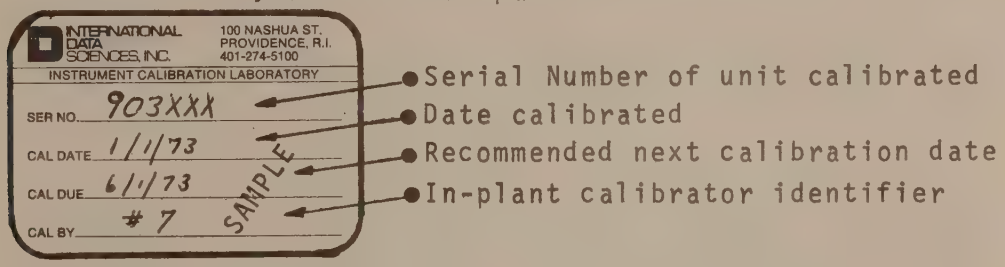


FIGURE 3 CLOCK/DATA INTERRELATIONSHIPS

CALIBRATION AND REPAIR SERVICE

All units sold by International Data Sciences, Inc. are calibrated at the time of delivery. International Data Sciences, Inc. recommends a periodic calibration every six months thereafter performed by the Calibration Department at International Data Sciences, Inc. The cost of this service is $25 for each calibration. If the unit requires repairs that are not covered by the original warranty, then IDS will perform the repair at a charge of $12 per hour plus parts. Normal turn-around time for calibration is two weeks.

Equipment so calibrated will bear a gummed label, illustrated below, on the rear panel.



All units returned to IDS for calibration will be accepted only if transportation charges are prepaid. The purchaser is also responsible for all transportation charges incurred in returning the calibrated unit to the purchaser.

For fast service DAX, Mark IV or Emery Air Freight are recommended. If time is not a problem, UPS is recommended. Return address should be clearly stated and should include a person to the attention of whom unit will be shipped.

Shipping cartons with proper foam packing are available from IDS at a price of $10 each. The carton will facilitate shipping the equipment to be calibrated with a maximum of protection.

WARRANTY

All International Data Sciences, Inc. instruments are warranted against defects in material, workmanship and component failures for a period of ninety days and against defects in material and workmanship for a period of one year. All units returned to IDS under this warranty require prepaid transportation charges. The purchaser is also responsible for all transportation charges incurred in returning the repaired unit to the purchaser.

Instruments to be returned under this Warranty require prior authorization by an International Data Sciences, Inc. representative or by the service manager of International Data Sciences, Inc.

International Data Sciences, Inc. reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of International Data Sciences, Inc., and International Data Sciences, Inc. neither assumes nor authorizes any person to assume for them any other liability in connection with the sales of International Data Sciences, Inc. instruments.

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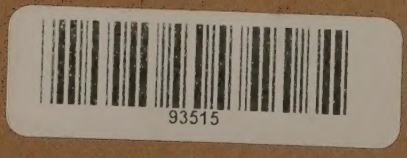
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